

## APPARATUS FOR MOLDING PLASTIC CAPS

### Background of the Invention:

Various apparatus have been proposed for molding plastic caps having hold-down lugs or inclined tabs adapted to engage underneath a shoulder on a container, such as a vial, to hold the cap in a closed, sealed position on the container.

Before removing the finished cap from the molding apparatus, it is necessary that the tab forming components of the molding apparatus and the molded cap be reoriented relative to each other so that the cap tabs are free from any obstruction in the mold cavity, whereby the finished cap can be stripped from the mold cavity.

The reorientation of the finished cap and the tab forming components of the molding apparatus relative to each other is usually accomplished by either moving the tab forming components away from the tabs on the finished cap, or rotating the finished cap in a direction away from the tab forming components in the molding apparatus.

The molding apparatus of the present invention is constructed and arranged to rotate the finished cap relative to the tab forming components in the molding apparatus.

Summary of the Invention:

5 The apparatus of the present invention for molding plastic caps having inclined tabs and radially inwardly extending ribs comprises, essentially, a conventional injection molding core machine having a fixed platen assembly supporting a core and a movable platen assembly carrying a female mold having a cup-shaped cavity. Fixed and movable plate assemblies are positioned between the platen assemblies and the core extends upwardly through the movable and fixed plate assemblies to the female mold. A plurality of vertically extending blades are secured to one of the movable plate assemblies and are slidably mounted in axial grooves provided on the exterior surface of the core. The upper end portion of the blades are provided with recesses having configurations corresponding to the inclined tabs and radially inwardly extending ribs on the plastic cap.

15 A linear drive member is mounted on one of the fixed plate assemblies and a ratchet sleeve is rotatably mounted on one of the movable plate assemblies and extends upwardly coaxially with the linear drive member. The ratchet sleeve is provided with a pair of axially extending, diametrically disposed offset slots which receive transverse pins connected to the linear drive member. The upper peripheral edge of the ratchet sleeve is provided with a

plurality of circumferentially spaced teeth between which the plastic, forming the lower edge of the skirt of the cap, flows during the molding operation.

By this construction and arrangement, when the movable plate assembly carrying the ratchet sleeve moves upwardly, the pin connection between the linear drive member and the ratchet sleeve causes the ratchet sleeve to rotate, whereby the teeth on the end of the ratchet sleeve, engaging the lower edge of the cap skirt, causes the cap to rotate relative to the upper end portions of the blades to thereby move the cap tabs and ribs away from the tab and rib forming recesses prior to stripping the finished cap from the apparatus.

Brief Description of the Drawings:

Figure 1 is a perspective view of the molding apparatus of the present invention;

Figure 2 is a perspective view of a vial having a cap thereon molded by the apparatus of the present invention;

Figure 3 is a sectional, side elevational view of the cap shown in Figure 2, without the dust cover;

Figure 4 is a perspective view of the cap shown in Figure 3;

Figure 5 is a bottom plan view of the cap shown in Figure 3;

Figure 6 is an enlarged, fragmentary, side elevational view of the molding apparatus of the present invention in the closed, cap forming position;

Figure 7 is a perspective view of the ratchet sleeve and upper end portions of the core and blades employed in the molding machine of the present invention;

Figure 8 is a view taken along line 8-8 of Figure 9;

Figure 9 is a view taken along line 9-9 of Figure 1; and

Figures 10, 11, and 12 are sectional, side elevational views illustrating the operation of the molding machine when molding the cap shown in Figure 3.

#### Description of the Preferred Embodiments:

Referring to the drawings and, more particularly to Figure 1, the molding apparatus 1 of the present invention comprises a conventional single cavity injection molding machine having a spine 2 mounted and vertically movable platen assembly 3 and a fixed platen assembly 4 upon which hydraulic cylinders 5 are mounted. The fixed platen assembly 4 and

hydraulic cylinders 5 are provided with a suitable housing 6 into which hoses 7 and 8 extend for the supply and exhaust of hydraulic fluid to the cylinders 5.

The injection molding machine is for molding vial caps 9 shown in Figures 2 to 5, and as disclosed in pending U.S. patent application S.N. 08/713,028 filed September 12, 1996, the disclosure of which is incorporated herein by reference. The cap 9 is adapted for sealing a glass vial 10 and is provided with a dust cover 10. The cap has a top wall 9a and a skirt portion 9b depending therefrom. The top wall 9a is provided with an opening 9c for holding the dust cover 10 thereon. The lower end of the skirt portion 9b is provided with a plurality of integral, inwardly, and upwardly extending tabs 9d adapted to engage the bottom surface of a shoulder on the neck of the vial 10 for securing the cap 9 to the vial 10, and a plurality of radially inwardly extending ribs 9e are integral with the inner wall surface of the skirt 9b, the ribs 9e being adapted to be inserted between the teeth of a gear finish on the neck of the vial 10, to thereby prevent the cap 9 from turning when secured to the vial 10.

The details of the construction of the apparatus for molding the cap 9 are illustrated in Figures 6 to 9 and comprise a conventional injection molding machine wherein the lower end of a vertically extending core 11 is secured to the fixed platen assembly 4. The upper end portion of the core 11 extends into a female mold 12 having a cup-shaped cavity carried by the movable platen assembly 3. The upper end portion of the core 11 is configured to form the

top wall 9a of the cap and the peripheral portions of the cap skirt 9b between the tabs 9d and ribs 9e.

In order to form the cap tabs 9d and ribs 9e, a plurality of axially extending blades 13 are slidably mounted in slots 11a (Figure 8) provided in the outer surface of the core 11. The lower ends of the blades 13 are secured to a movable plate assembly 14, and the upper end portions of the blades 13 are provided with recesses 13a and 13b having configurations corresponding to the cap tabs 9d and ribs 9e, respectively.

Figure 9 shows the injection molding machine in the closed position for molding the cap 9 wherein plastic is injected through the spine 2 through a gate 2a into the cup-shaped cavity of the female mold 12. The upper end portions of the core 11 and blades 13 are spaced slightly radially inwardly from the inner wall of the female mold to provide a clearance into which the plastic flows to form the cap 9.

Before the finished cap 9 can be removed from the mold 12, it has to be reoriented within the mold 12 to move the tabs 9d and ribs 9e out of their respective blade recesses 13a, 13b. To this end, a linear drive member 15 is mounted in a fixed plate assembly 16, and a ratchet sleeve 17 is positioned coaxially within the linear drive member 15 and has its lower end supported on the movable plate assembly 14 and rotatably mounted thereon by suitable bearings 18. The ratchet sleeve 17 extends upwardly through the fixed plate assembly

16 and is rotatably mounted therein by a bearing 19. The ratchet sleeve 17 is provided with a pair of axially extending, diametrically disposed offset slots 17a which receive transverse pins 20 connected to the linear drive member 15. The upper peripheral edge of the ratchet sleeve 17 is provided with a plurality of circumferentially spaced teeth 17b between which the plastic, forming the lower edge of the cap skirt, flows during the molding application.

By this construction and arrangement, when the movable plate assembly 14 carrying the ratchet sleeve 17 is moved upwardly, the pin connection 20 between the linear drive member 15 and the ratchet sleeve 17 causes the ratchet sleeve 17 to rotate, whereby the teeth 17b on the end of the ratchet sleeve 17, engaging the lower edge of the cap skirt, causes the cap 9 to rotate relative to the blades 13, to thereby move the cap tabs 9d and ribs 9e out of their respective recesses 13a, 13b.

The upward movement of movable plate assembly 14 is accomplished by the hydraulic cylinders 5 connected at their upper ends to a movable plate 14a having a depending rod 14b extending downwardly through the fixed plate assembly 16 and slidably mounted therein. The lower end of the rod 14b is provided with a spring tensioned telescopic portion 14c, and a friction sleeve 14a mounted in the movable plate assembly 14. As the hydraulic cylinders 5 are extended, as shown in Figure 10, the movable plate 14a is pushed upwardly away from the top surface of the fixed plate assembly 16. The rod 14b, carried by the movable plate 14a, pulls the movable plate assembly 14 upwardly until the movable plate assembly 14 engages the

bottom surface of the fixed plate assembly 16 as shown in Figure 11. Continued upward movement of the movable plate 14a, as shown in Figure 12, is accommodated by the extension of the telescopic portion 14c of the rod 14b.

To complete the structure of the molding apparatus, suitable guide rods 21, 22  
5 extend between the fixed plate assembly 16 and the movable plate 14a, having a stripper 23 mounted therein, and a coolant tube 24 is fixed at its lower end to the fixed platen assembly and extends upwardly into the core 11.

In the operation of the molding apparatus of the present invention, the  
components of the injection molding machine are initially in the closed position as shown in  
Figure 9, wherein plastic is injected through the spine 2, gate 2a, and into the cup-shaped cavity  
of the female mold 12, wherein the configurations of the upper end portions of the core 11 and  
blades 13, together with the cup-shaped cavity, form the cap 9. After the plastic has set, the  
movable platen 3 is raised, as shown in Figure 10, and the hydraulic cylinders 5 are extended to  
raise the movable plate 14a away from the top surface of the fixed plate assembly 16 while  
15 simultaneously moving the movable plate assembly 14 upwardly toward the bottom surface of  
the fixed plate assembly 16. Since the blades 13 and ratchet sleeve 17 are mounted on the  
movable plate assembly 14, they too slide upwardly relative to the core 11 which is mounted on  
the fixed platen 4. The ratchet sleeve 17 also slides upwardly relative to the linear drive member  
15. During this upward movement, the pins 20 on the linear drive member 15 slide in the slots



17a of the ratchet sleeve 17. Since the first portion of the slot 17a is axial, as shown schematically in Figure 10, there is no rotation of the ratchet sleeve 17. Continued upward movement of the movable plate assembly 14 and movable plate 14a, as shown in Figure 11, will result in the linear drive member pins 20 sliding in the offset portions of the slots 17a causing the ratchet sleeve 17 to rotate substantially 60°. Since the teeth 17b on the end of the ratchet sleeve 17 are connected to the lower peripheral edge of the cap 9, the cap is rotated relative to the blades 13 so that the cap tabs 9d and ribs 9e are moved clear of the blade recesses 13a, 13b. The cap 9 is now in position for removal from the molding apparatus which is shown in Figure 12, wherein continued upward movement of the movable plate 14a causes the stripper 23 to engage the lower edge portion of the cap skirt to thereby push the cap 9 out of engagement with the ratchet sleeve teeth 17b.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to, without departing from, the spirit of the invention or scope of the subjoined claims.